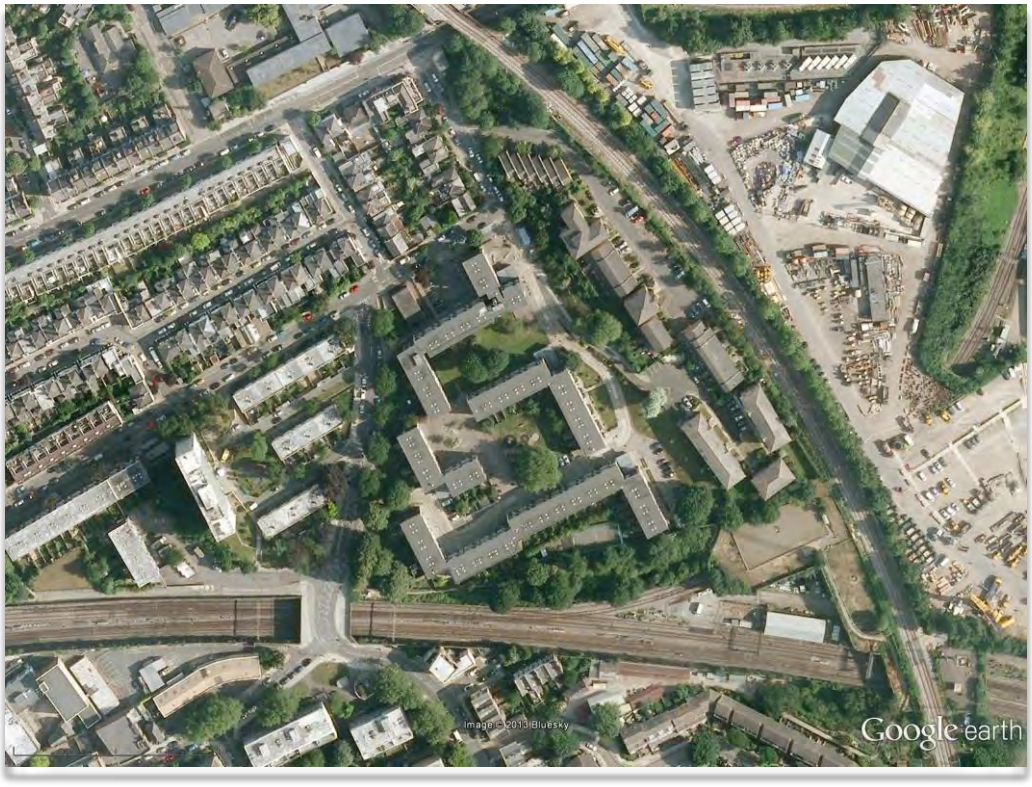
Intended for
Camden Council

Document type
Desk Study

Date
October 2014

KILN PLACE
GEOTECHNICAL AND ENVIRONMENTAL DESK STUDY



RAMBOLL

KILN PLACE
GEOTECHNICAL AND ENVIRONMENTAL DESK STUDY

Revision	**2**
Date	**14.10.2014**
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Description	**Geotechnical and Environmental Desk Study**
Ref	61031879-KP-GE/EV-RPT-001

Revision History

Revision	Date	Purpose /Status	Document Ref.	Comments
-	02.12.2013		61031879-KP-GE/EV-RPT-001	
1	19.09.2014	Final	61031879-KP-GE/EV-RPT-001	Amended to include updated site layout
2	14.10.2014	Final	61031879-KP-GE/EV-RPT-001	Amended Figure 5 and comments for planning

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1. INTRODUCTION

Ramboll has been appointed by EC Harris on behalf of Camden Council, to undertake a combined geotechnical and environmental desk study of Kiln Place, Gospel Oak, London, which is proposed for the construction of additional residential buildings.

The purposes of this report are to identify potential risks which could be present with respect to ground conditions at the site. These include:

- Soil and groundwater quality with respect to human health of users and the wider environment, and implications of soil and groundwater quality for redevelopment.
- Identifying the underlying ground conditions and highlight any potential geotechnical hazards which may impact on the design of the substructure.

A plan showing the location and extent of the study site is provided in Figure 1.

2. OBJECTIVES AND SCOPE OF WORK

This appraisal of the site provides an initial assessment of the potential risks and constraints on development with respect to geotechnical engineering and land contamination, and identifies issues that may need further study or mitigation. The report is intended for submission to the local planning authority, and to inform the design of intrusive investigations.

On this basis the scope of the study is as follows:

i. Present factual data with regard to the historical and environmental setting of the site and its immediate surroundings;

ii. Formulate an initial conceptual site model and preliminary qualitative risk assessment; and

iii. Interpret this information in terms of implications for further work, construction and design of the project.

Limitations and standards under which this report has been completed are given in Appendix A.

This report does not cover any issues other than geotechnical engineering and contaminated land. For example, no ecological or archaeological studies are included within the scope of this report.

2.1 Information Sources

This report is based upon information derived from a variety of sources as listed below:

i. Ground Engineering Site Investigation Report (2011) Report reference C12381;

ii. The Environment Agency (EA) - online environmental data ('What's in Your Backyard?') maps (accessed November 2013);

iii. Health Protection Agency - Indicative Atlas of Radon in England and Wales (November 2007);

iv. Building Research Establishment (BRE) - Radon Protection Measures for New Buildings (2007);

v. British Geological Survey (BGS) - 1:50,000 scale geological mapping, solid and drift (accessed digitally via the BGS website October 2013 and paper map Sheet 256 North London);

vi. Zetica - Unexploded Ordnance (UXO) Risk Maps for London North area (accessed October 2013);

vii. British Geological Society (BGS) - borehole log database (accessed digitally via the BGS website October 2013);

viii. CIRIA – report C552: Contaminated Land Risk Assessment – A Guide to Good Practice (2001);

xiii. Review of online aerial photography (accessed October 2013).

2.2 Consultation

Enquiries were raised with Camden Council Environmental Health department to determine whether this department has any records regarding ground conditions at the site. It was not considered necessary to consult with other regulatory bodies at this stage. No responses to the consultation were received at the time of writing of this report.

2.3 Location

The site is centred at National Grid reference TQ 28331 85485 (post code NW5 4AJ) and covers an area of approximately 15,300 square metres (1.53 ha). A plan showing the site location is provided in Figure 1. The site is currently occupied by residential dwellings, car parking and green, open communal areas which includes a play area. Surrounding land comprises mixed uses, including residential dwellings, industrial land and railway. The current layout of the site is shown in Figure 2.

2.4 Development Proposals

It is proposed to construct one to four storey residential dwellings in both stand-alone blocks and infilling of space created by existing buildings. Private gardens are proposed for one row of dwellings in the north of the site. Landscaping is likely to remain unchanged from what is currently on site.

Following the issue of Rev 0 of this document, the proposed development has been updated to accommodate an underlying Thames Water sewer and the addition of proposed dwellings. As a result of the sewer main it is proposed to construct a series of cantilever residential dwelling of up to four storeys as detailed on the latest layout drawing 116_P_01P Rev E. Plans of the proposed development options are shown in Figure 3.

3. SITE DATA

3.1 Site History[1]

Late 19th Century

From the earliest available maps, dating to the 1860s, the site is open land with a steeply sloping embankment sloping up to the north east, running the entire length of the eastern site boundary. A drain is shown following the toe of the slope crossing the eastern part of the site. Houses are located to the north of the site, fields to the east and west and the Midland Railway to the south. The London and North Western Railway (L & N.W.R) is located further east.

By 1894 – 1896 Gospel Oak Brickworks has been constructed on the site. The area surrounding the brick works is shown as fields. The embankment along the eastern boundary still remains, however the drain is no longer shown and has possibly been culverted. Immediately south of the site, the Tottenham North line of the Midland Railway has been constructed and enters a tunnel under the L & N.W.R.

Beyond the railway to the north east is Alliance Coal Depot and beyond the railway to the south is a timber yard.

[1] Ground Engineering – Site Investigation Report Kiln Bank, Kiln Place (May 2011)

Pre-World War II

By the 1916, the Gospel Oak Brickworks has expanded and altered in building layout. There are areas of excavation with water both on site and to the west of the site. The embankment along the eastern boundary still remains, with buildings constructed immediately to the east.

Beyond the railway to the south the timber yard has expanded.

20th Century - Post World War II

The site is unchanged following World War II and the buildings seem undamaged, however houses and factories surrounding the site have suffered general blast damage.

By 1954, the majority of the buildings, pits and ponds associated with the brickworks have gone and the kiln is shown as disused. The embankment along the eastern boundary still remains and the buildings immediately to the east are named as Slag Wool Works. The south western corner of the site is now a timber yard.

By 1968, the site has been redeveloped and Kiln Place housing estate constructed. Grafton Road has been constructed and forms the western site boundary. Houses have been constructed on the land to the west of the road. The Slag Wool works has been redeveloped and named 'works' with a depot. The embankment which forms the eastern boundary appears to have been widened and possibly increased in height.

Late 20th Century – 21st Century

By 1980, a builder's yard is present at the top of the embankment to the south east of the site, which by 1995 has become houses.

By 2003, the former works and depot has been cleared and the site redeveloped with housing along Hemmingway Close.

3.2 Geology and Geological Associated Hazards

The British Geological Survey 1:50,000 series sheet 256 (Solid & Drift edition) for North London indicates that the site is underlain by Eocene London Clay Formation (LCF). Approximately 100 metres north and west of the site the geological map indicates the presence of Eocene Claygate Beds overlying the LCF. Head deposits are shown 150 metres south and 200 metres northeast of the site, associated with steep slopes.

Historic exploratory hole / water well records available from the British Geological Survey (BGS) website confirm the anticipated geology identified from the BGS map and are summarised in Table 1. The historic exploratory hole logs also indicate the presence of possible Head deposits overlying the LCF. Borehole logs do not extend beneath the base of the underlying the London Clay. The boreholes lie approximately 60 metres west of the site boundary.

The exploratory hole logs do not reach the base of the LCF but the weathered London Clay unit is recorded at 3.3 metres below ground level (mbgl) and the unweathered unit is at 10.0 mbgl. The LCF is described in the historical logs as firm to stiff, brown to dark grey fissured clay. The BGS describes the basal LCF as a hard dark shelly loam at the transitional zone with the Lambeth Group.

Strata	**Historical Borehole, Year and Depth to Base of Stratum (m)**		
	BH 1951 Lamble Street		**BH1 2011**
Made Ground granular	0.6	4.11	0.6
Made Ground cohesive	1.2		1.85
Head	1.8	4.35	3.3
London Clay Formation (LCF)	unproven		unproven
Water mbgl*	1.2	4.2	Dry, 9.98, 6.13, 4.95

Table 1 – Strata from Historical Exploratory Holes

3.3 Hydrogeology

The site is underlain by unproductive strata (non-aquifer) comprising the LCF. It does not lie within a groundwater Source Protection Zone. Neither is it within a designated Nitrate Vulnerable Zone. The site is not located above any groundwater bodies designated under the Water Framework Directive.

There are no water abstraction licenses held on, or within 250 metres of the site[1].

3.4 Hydrology

There are no surface water features on the site. The River Fleet flows underground and is a tributary to the River Thames. It now forms part of what is the London sewer system and is believed to have branches located both to the east and west of the site (see Figure 4)[2], joining together to the south of the site.

The site is located in Flood Risk Zone 1 i.e. where there is less than a 0.1% (1 in 1000) chance of flooding occurring each year[3]. There are no flood defences within 250 metres of the site. The British Geological Survey indicates a negligible susceptibility to groundwater flooding based on the underlying geology.

The northern end of the site is, however, shown on the Environment Agency website as being within the maximum extent of the risk of flooding from Hampstead Pond No. 1 reservoir (see Figure 4). This is the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a worst case scenario, it is unlikely that any actual flood would be this large.

The site is not located within the vicinity of any waterbodies designated under the Water Framework Directive. The Flood Risk Assessment submitted with the planning application confirms that the risk of flooding from fluvial sources and the reservoir is considered to be negligible.

3.5 Ground Gases (including Radon)

The Health Protection Agency (HPA) Indicative Atlas of Radon in England and Wales (2007) indicates that the site lies in an area where 0% - 1% of homes are above the UK Action Level for radon. The Building Research Establishment guidance document 'Radon Protection Measures for New Buildings (2007)' states that radon protection is not required for residential developments in such areas.

3.6 Waste

The EA website does not indicate any historical landfill sites within 1 kilometre of the site. A recycling centre is shown located approximately 500 metres to the south east of the site. There are no recorded waste transfer stations or active landfills within 250 metres of the site[1].

3.7 Sensitive Land Use

There are no sites designated for their sensitive use (e.g. nature designations) within 1 kilometre of the site.

3.8 Unexploded Ordnance

Bomb risk maps searched online (Zetica Ltd) identify the site to be in an area of medium to high risk. The 'Bombsight' website[4] provides access to National Archive records of bombs that fell on London during the Blitz. This indicates that a High Explosive bomb fell on Lamble Street in 1940 or 1941. Further bombs were recorded within several hundred metres of the site.

[2] Paul Talling - Lost Rivers of London (2011)

[3] Environment Agency 'What's in Your Backyard?' website, accessed November 2013

[4] http://www.bombsight.org/#14/51.4760/-0.1541

3.9 Environmental Permits and Authorisations

No sites relating to statutory authorisations, enforcement or prohibition notices are recorded as being located on or adjacent to the site[1]. Additionally there are no records of pollution incidents and the site is not registered in the local authority contaminated land register[1].

3.10 Contaminative Land Uses

The site is currently developed for residential use and there are no current recorded potentially contaminative uses within the site boundary[1]. Historical potentially contaminative uses recorded within 50 metres of the site were recorded in 2011[1] as including an electricity sub-station, railway land and depot.

3.11 Existing Ground Investigation Data

A ground investigation was undertaken in 2011 as part of the development of Kiln Bank, Kiln Place[1]. As part of this investigation one borehole (BH) and two trial pits (TP) were excavated in the area of Kiln Place East. Made ground at these locations contained anthropogenic material that included concrete, ash, brick fragments, glass, coal and chalk.

Three soil samples were taken from these locations, near the surface, and submitted to chemical analysis. The results of the analysis were compared to Soil Screening Values (SSV) developed utilising guidance current at that time from the Environment Agency and Defra. For residential use without home grown produce, exceedances of the derived SSV were detected for lead, benzo(a)pyrene and 1,1,2,2-tetrachloroethane (a chlorinated solvent). No visual or olfactory evidence of hydrocarbons was detected in any of the locations.

Concentrations of ground gas were monitored on three occasions in the borehole. The gas concentrations detected were indicative of a very low risk as defined in guidance at that time[5]. The borehole was not located in an area identified on the historical maps as being excavated and the number of visits was low.

4. DISCUSSION OF GEOLOGICAL STRATA AND GEOTECHNICAL RISKS

From the information obtainable to date the following sections highlight the geotechnical constraints that will potentially impact on the development of the site.

4.1 Strata

Made/worked Ground

This was encountered in all exploratory holes as is described as brown and grey sand and gravel comprising flint, brick and concrete fragments over firm locally soft clay containing ash and brick fragments. Investigation locations did not include those identified from the historical maps as having been excavated.

Head (Brickearth)

Head is described as firm to locally stiff orange brown and grey clay with occasional gravel of flint towards the base of the strata. The strength of the head deposits is likely to be in the order of 60 kPa.

London Clay Formation

BH1 located at the site described the LCF as firm becoming stiff, fissured silty clay with occasional limestone (probably claystone) nodules.

Very limited information is currently available regarding the underlying LCF at the site. The strength of the upper part of the LCF will be dependent upon its weathering state. In weathered zones the LCF is described as firm becoming firm to stiff in strength in the order of 60 kPa

[5] CIRIA – Report C665: Assessing Risks Posed by Hazardous Ground Gases to Buildings (2007)

increasing with depth. Below the weathered zones, the LCF comprises a stiff to very stiff with undrained shear strengths in the order of 150 kPa increasing with depth.

From the brief descriptions contained in the BGS historic records this deposit is also described as having a sandy secondary constituent and therefore the stratum may also be water bearing. The limited geotechnical laboratory test data currently available for the site shows the LCF to have a very high plasticity and therefore potentially will exhibit a high volume change potential.

Chemically the cohesive material can exhibit substantial sulphate concentrations leading to a potentially aggressive chemical environment. Substructure concrete in particular (shallow foundations) will need to be designed in accordance with BRE Special Digest 1:2005 'Concrete in Aggressive Ground' 3rd Edition.

4.2 Groundwater and Use of Soakaways

Records of groundwater level available from the ground investigation carried out in 2011 and exploratory holes carried out in 1951 are summarised in Table 2.

Exploratory Hole	Date	Groundwater Level (mbgl)
A	1951	4.2
B		1.2
BH1	11/04/2011	Dry
	15/14/2011	9.98
	13/05/2011	6.13
	26/05/2011	4.95

Table 2 – Groundwater strike Levels from Historical Exploratory Holes

Ground investigation records indicate that it is likely that groundwater is present in the Brickearth perched on the LCF at a depth generally between 4.0 mbgl and 5.0 mbgl.

Due to the anticipated cohesive nature of the underlying ground conditions it is envisaged that the site will not be suitable for the use of soakaways.

4.3 Foundations

The foundation solution of the proposed one to four storey dwellings will be dependent upon confirmation of the ground and groundwater conditions present at the site and the structural form of the buildings.

Should shallow spread foundations be adopted then these would need to be founded in either head deposits or the underlying LCF. Should firm head deposits be encountered near surface then for a founding depth of 2.0 metres the allowable bearing capacity would typically be in the order of 75 kN/m² to 125 kN/m² for square pad foundations up to 3.0 metres in width and strip foundations up to 1.5 metres in width.

Should stiff LCF be encountered near surface then for a founding depth of 3.0 metres the allowable bearing capacity would typically be in the order of 125 kN/m² to 175 kN/m²for square pads foundations up to 3.0 metres in width and strip foundations up to 1.5 metre width.

Shallow foundation depths should be subject to the NHBC guidance for building near trees (Part 4 of the NHBC Standards 2007).

Should the allowable bearing pressure of the shallow spread foundations prove inadequate to support the proposed loads, or the settlement criterion dictate, then a piled foundation solution for the proposed structures would be required. It is likely that continuous flight auger (CFA) piles are recommended due to the proximity to residential properties and noise/vibrations caused by other piling methods. The piles would be embedded into the LCF where the strength of the material (derived from ground investigation works) would be adequate to support the required loads. Pile design should be undertaken in accordance with BS EN1997-1:2004 'Geotechnical Design', with further guidance from the London District Surveyors Association 'Guidance Notes for the Design of Straight Shafted Bored Piles in London Clay'.

4.4 Trees

Currently the perimeter of the site is bounded by trees and hedgerows with several single trees located throughout the site. There are semi-mature Willow trees located along the north east boundary, some of which had curved trunks possibly indicating slope movement.

Historic exploratory hole logs indicate to the site being underlain by cohesive material and therefore it is recommended that geotechnical laboratory testing is carried out to determine the plasticity and moisture content of the clays to assess the potential volume change.

The underlying soils impose a risk for potential shrinkage and heave, and any existing or proposed trees located within the vicinity of the proposed development should be considered with regards to foundation design in regard to moisture content and especially if clays have high plasticity.

Shallow foundation depths should be subject to the NHBC guidance for building near trees (Part 4 of the NHBC Standards 2007).

5. DISCUSSION OF CONTAMINATED LAND RISKS

The UK framework for assessment of contaminated land is outlined in Appendix A. The basis of this framework is that for significant contamination to be present there must be a Source – Pathway – Receptor linkage in place. Further details of this are presented in the appendix.

Review of available documentary sources indicates that there is the potential for contamination to occur on the site resulting from the historical use of the site as:

- Brickworks (including backfill of excavations)
- Timber yard
- Railway embankment

And also from neighbouring site uses as:

- Railway (including embankment)
- Builder's yard
- Slag wool works/works
- Coal depot
- Timber yard

No current uses have been identified, either on site or in the vicinity that would indicate the presence of a significant risk.

A preliminary risk assessment and conceptual site model is given in Table 3 below. This assessment is based on residential development at the site, but with no private gardens where food might be grown.

Table 3 – Preliminary Conceptual Site Model and Risk Assessment (without mitigation)

Potential Source/ Location	Potential Contaminant(s)	Pathway	Potential Receptor	Probability of Risk Being Realised*	Consequence of Risk Being Realised*	Risk Classification*
Former brickworks • Potentially backfilled pits (Made Ground (MG)) • Potential made ground (MG) from levelling of the site (on-site and off-site)	Ground gas	Migration into buildings	Asphyxiation of building users	Likely	Severe	High (where plots placed over brickworks extraction areas)
		Migration into buildings	Damage to buildings	Likely	Severe	
	Waste products in fill material on site (e.g. asbestos, metals, polycyclic aromatic hydrocarbons (PAHs) and hydrocarbons, volatile and semi-volatile organic compounds)	Contact pathways, inhalation of soil and soil derived dust	End users	Unlikely	Mild	Very low
			Ground-workers	High likelihood	Minor	Moderate/low
		Inhalation of fibres (asbestos only)	End users	Unlikely	Severe	Moderate/low
			Ground-workers	Low likelihood	Severe	Moderate
		Plant uptake	Phytotoxic conditions for plant growth	Unlikely	Minor	Very low
		Vapour inhalation	Ground-workers	Low likelihood	Minor	Very low
			End users	Unlikely	Mild	Very low
		Leaching to groundwater	Groundwater	Unlikely	Minor	Very low
Timber/Builder's yards (on-site and off-site)	Asbestos, metals, PAHs, hydrocarbons, organochlorines, phenols, herbicides, pesticides	Contact pathways, inhalation of soil and soil derived dust	End users	Unlikely	Mild	Very low
			Ground-workers	High likelihood	Minor	Moderate/low
		Inhalation of fibres (asbestos only)	End users	Unlikely	Severe	Moderate/low
			Ground-workers	Low Likelihood	Severe	Moderate

Potential Source/ Location	Potential Contaminant(s)	Pathway	Potential Receptor	Probability of Risk Being Realised*	Consequence of Risk Being Realised*	Risk Classification*
		Leaching to groundwater	Groundwater	Unlikely	Minor	Very low
		Vapour inhalation	Ground-workers	Low likelihood	Minor	Very low
			End users	Unlikely	Mild	Very low
Railway land (including embankment) (off-site)	Asbestos, metals, PAHs, ash, hydrocarbons, herbicides, creosote, sulphates, solvents.	Contact pathways, inhalation of soil and soil derived dust	End users	Unlikely	Minor	Very low
			Ground-workers	Unlikely	Minor	Very low
		Inhalation of fibres (asbestos only)	End users	Unlikely	Severe	Moderate/low
			Ground-workers	Unlikely	Severe	Moderate/low
		Leaching to groundwater and migration to site via groundwater	Groundwater	Unlikely	Minor	Very low
		Vapour inhalation from groundwater	Ground-workers	Unlikely	Minor	Very Low
			End users	Unlikely	Minor	Very low
Slag Wool Works/works (off-site)	Depends on type of slag used. Could be relatively inert or contain metal oxides, sulphates/ sulphides and have a high pH	Contact pathways, inhalation of soil and soil derived dust	End users	Unlikely	Minor	Very low
			Ground-workers	Unlikely	Minor	Very low
Coal Depot (off-site)	Coal/coal dust with hydrocarbons and metals	Contact pathways, inhalation of soil and soil derived dust	End users	Unlikely	Minor	Very low
			Ground-workers	Unlikely	Minor	Very low

* For a definition of terms please see Appendix A.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Key Findings

The site is currently a housing estate and has historically (pre 1970) been used as a brickworks with pits and ponds. It is anticipated that there will be made ground and buried structures at the site.

The area immediately surrounding the site has a varied industrial history, but is now replaced with housing. Industrial land uses have included railways, slag wool works, a coal depot, timber yards and a builder's yard. Given the nature of the historical industries outside of the site, and the impermeable nature of the geology beneath the area, contaminants from these industries are considered unlikely to migrate towards the site.

Previous historic use of the site itself presents a possible risk in terms of contaminants and potential for ground gases from filled areas. Initial assessment of the potential risks indicates that these might be mitigated through provision of standard personal protective equipment (PPE) during the construction period. However, elevated concentrations of contaminants were detected in a previous ground investigation at the site, and it is thus recommended that soil samples be taken within the footprints of the proposed development in order to clarify the status of the ground at these locations. Additionally, filled areas have the potential to contain gas-generating material and the risk associated with this should be quantified through ground gas monitoring.

Chemically the LCF can exhibit substantial sulphate concentrations leading to a potentially aggressive chemical environment.

The underlying cohesive soils impose a risk for potential shrinkage and heave, and any existing or proposed trees located within the vicinity of the proposed development should be considered with regards to foundation design in regard to moisture content and especially if clays have high plasticity.

6.2 Recommendations for Further Work/Ground Investigation

To enable detailed design of the proposed residential dwellings, it is recommended that a combined geotechnical and contaminated land ground investigation is designed and undertaken in accordance with BS EN 1997-2:2007 'Ground Investigation and Testing'. The intrusive investigation should be designed to ascertain the following.

Environmental:

- Soil character, particularly in terms of potential contaminants which may pose a significant risk, but also a wide enough suite to undertake initial waste characterisation, should the need for soil disposal be identified;
- Sampling and analysis of groundwater, should it be encountered; and
- Ground gas regime including vapour monitoring (if necessary)

Geotechnical:

- Strength and stiffness of the soils;
- Classification testing of the various soil types, in particular moisture contents and Atterberg Limits;
- Information with respect to the existing groundwater levels; and
- Chemical properties of the soil (in particular any Made Ground deposits and of the LCF and groundwater for determining the classification of buried concrete.

Proposed Ground Investigation

Based on the proposed layout of dwellings issued at the time of writing this document Rev. 0 (ref drawing: 116_P_01P Rev B), a preliminary ground investigation should comprise a combination of the following techniques:

- Cable percussive boreholes – to enable in-situ testing and collection of soil samples for both geotechnical and contamination laboratory analysis, engineering descriptions of the LCF and installation of combined gas and groundwater monitoring installations. It is recommended that the boreholes are drilled to a depth of approximately 15 mbgl;
- Windowless sampling – to enable ground conditions to be assessed to depths of up to 8 mbgl;
- Monitoring of water levels in installations once a week for four weeks, commencing at least two weeks after completion of the wells, following completion of site investigation works; and
- Monitoring of ground gas concentrations (allowance should be made for nine visits over a period of six months, unless consultation with Camden Council concludes that other arrangements are acceptable).

An allowance of around 10 weeks – 12 weeks should be made from the commencement of intrusive works to interpretation of the findings of the investigation. Ground gas monitoring will continue after this period in order to complete the required number of monitoring visits

6.3 Unexploded Ordnance

Records indicate that bombs fell in the vicinity of the site during World War II. As such the risk of encountering UXO during any intrusive works cannot be discounted and actions to mitigate the risk should be considered. Prior to any intrusive investigation work carried out, it is recommended that the Client carries out a risk assessment in accordance with the guidelines set out in CIRIA C681, Unexploded Ordnance: 'A Guide for the Construction Industry' (2009).

6.4 Flood Risk

Camden Council was consulted with respect to flood risk as part of the Flood Risk Assessment for the site (report 61031879-KP-EV-FRA-001). Their response is detailed in the FRA and does not refer to the need to comply with any local emergency plans for the reservoir.

6.5 Implications for Design and Construction

Design

Ground gas protection and clean cover systems are required. The gas protection needs to be designed in line with the gas regime identified, and meet at least the minimum requirements for a site classified under the CIRIA system as Characteristic Situation 2 (CS2). This is discussed in detail in the Ground Contamination Interpretative Report.

Should areas of soft landscaping be proposed, the soil conditions would need to be verified as being suitable for this use. Allowance should be made for clean topsoil cover to landscaped areas.

Should services be required at the site, the soil conditions may be such that the types of services materials (such as water supply pipes) would need to be chosen such that unacceptable risks would not be posed to end users or ground workers.

Findings of any site investigation works could be used to provide an indication regarding the potential for aggressive ground conditions from which an assessment could be made with regards to concrete classifications.

Should any fill material or topsoil be imported to the site, this should be sampled and tested to verify that it is suitably clean for the proposed use. The sampling regime should be defined by an environmental specialist.

An updated site layout (116_P_01P Rev. E) has been issued following the issue of this document Rev. 0 and the completion of recommended ground investigation. Due to the proposed increase in structure height it is likely that the founding depth will increase and therefore the design and build contractor may undertake additional ground investigation at this location if deemed necessary.

Construction

A standard level of PPE provision is considered to be appropriate for ground-workers on this site. Gas monitoring should be undertaken in excavations, specifically in backfilled areas, in order to manage the risk of ground gas exposure.

Soils proposed for re-use on site may need to be tested and verified as being suitable for use prior to being reused. Soils which are to be removed from the site will require testing to determine their character for waste disposal purposes.

6.6 Consultation

It is recommended that this report be submitted to the Local Authority Contaminated Land Officer (CLO) for comment prior to undertaking any further investigation. Best practice would be to agree the scope of the further ground investigation with the CLO prior to commencing the work.

APPENDIX A

LIMITATIONS & STANDARDS

This report is intended for the stated Client for the purpose of assisting them in evaluating the site in the context of the potential development. This report should not be used in whole or in part by any third parties without the express permission of Ramboll in writing.

Ramboll has endeavoured to assess all information provided to them. The report includes summaries of information from external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon. The proposed geotechnical design options and recommendations summarised in this report relate to the feasibility of developing on the site are based on information gained at the time of writing the report. Any substantial changes to the use of the site may require a reassessment of the implications of the risks identified and a review of the geotechnical design options.

No site walkover has been carried out.

It should be noted that some of the aspects considered in this study are subject to change with time. If the development is postponed or delayed for a significant period, this report should be reviewed to confirm whether changes have taken place, either at the site or within relevant legislation. Similarly, this report (and the risk assessment contained within) is based on the end use specified. If this end use is changed, the risk assessment must be reviewed and amended as appropriate.

Any observations or comments made within this report with respect to asbestos are intended to assist the client and do not constitute an asbestos survey. Ramboll are not asbestos specialists and we recommend that you appoint an asbestos consultant to advise you.

No intrusive ground investigation works were undertaken as part of this study.

Environmental risks are assessed in accordance with Contaminated Land (England) (Amendment) Regulations 2012, Part IIA of the Environmental Protection Act 1990, and Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, DEFRA 2012. Part IIA provides a statutory definition of contaminated land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

(a) Significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted and the potential pathways between them. For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source - a substance that is capable of causing pollution or harm;
- A receptor - something which could be adversely affected by the contaminant; and
- A pathway - a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

The Environment Agency Contaminated Land Report CLR 11 Model Procedures for the Management of Land Contamination provides the technical framework for structured decision making about land contamination. CLR 11 advocates a phased approach to risk assessment comprising:

- Preliminary Risk Assessment (PRA) – desk study and qualitative assessment
- Generic Quantitative Risk Assessment (GQRA) – assessment of contaminant concentrations against generic assessment criteria.
- Detailed Quantitative Risk Assessment (DQRA) – detailed site specific risk assessment and development of site-specific assessment criteria.

Each of these phases follows the same basic steps buts adds site specific details and further certainty into the assessment as the stages progress.

RISK ESTIMATION

An assessment of environmental risks is made for each potential pollutant linkage identified.

Risk estimation has been completed in accordance with the guidance provided in:

NHBC and Environment Agency 2008. *Guidance for the Safe Development of Housing on Land Affected by Contamination*. R&D Publication 66: 2008.

The following is taken directly from NHBC/EA 2008. The key to the classification is that the designation of risk is based upon the consideration of both:

a) the magnitude of the potential consequence (i.e. severity). [takes into account both the potential severity of the hazard and the sensitivity of the receptor]

b) the magnitude of probability (i.e. likelihood). [takes into account both the presence of the hazard and receptor and the integrity of the pathway]

Category	Definition
Severe	Highly elevated concentrations **likely** to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs. Equivalent to EA **Category 1** pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs. Equivalent to **EA Category 2** pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.
Mild	Exposure to human health **unlikely** to lead to "significant harm". Equivalent to **EA Category 3** pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.

* For these purposes, disease is to be taken to mean an unhealthy condition of the body or a part of it and can include, for example, cancer, liver dysfunction or extensive skin ailments. Mental dysfunction is included only insofar as it is attributable to the effects of a pollutant on the body of the person concerned.

Table 1 Classification of Consequence (after NHBC/EA 2008)

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Category	Definition
High Likelihood	There is pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place, and is less likely in the shorter term.
Unlikely	There is pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 2 Classification of Probability (after NHBC/EA 2008)

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	**Very high**	High	Moderate	Low
	Likely	High	Moderate	Moderate/ Low	Low
	Low Likelihood	Moderate	Moderate/ Low	Low	Very low
	Unlikely	Moderate/ Low	Low	Very low	Very low

Table 3 The Classification of Risk (after NHBC/EA 2008)

Very high risk

There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.

High risk

Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.

Moderate risk

It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.

Low risk

It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

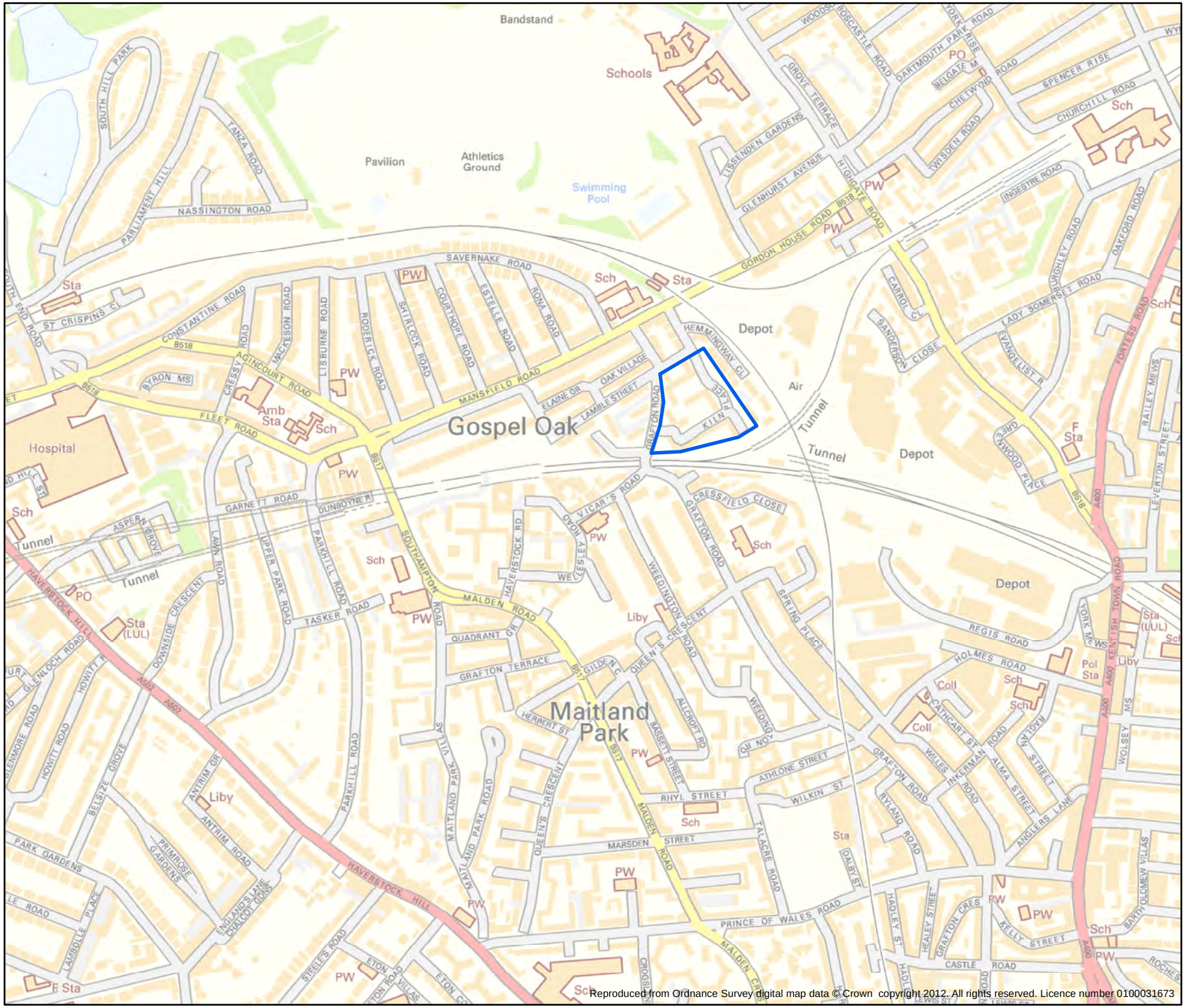
Very low risk

It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.

No potential risk

There is no potential risk if no pollution linkage has been established.

FIGURES



Key

Site Boundary

Scale at A4 - 1:8,000

N

Client

Camden Council

Project Title

Kiln Place, Camden

Project Number

61031879

Figure Title

Site Location

RAMBOLL

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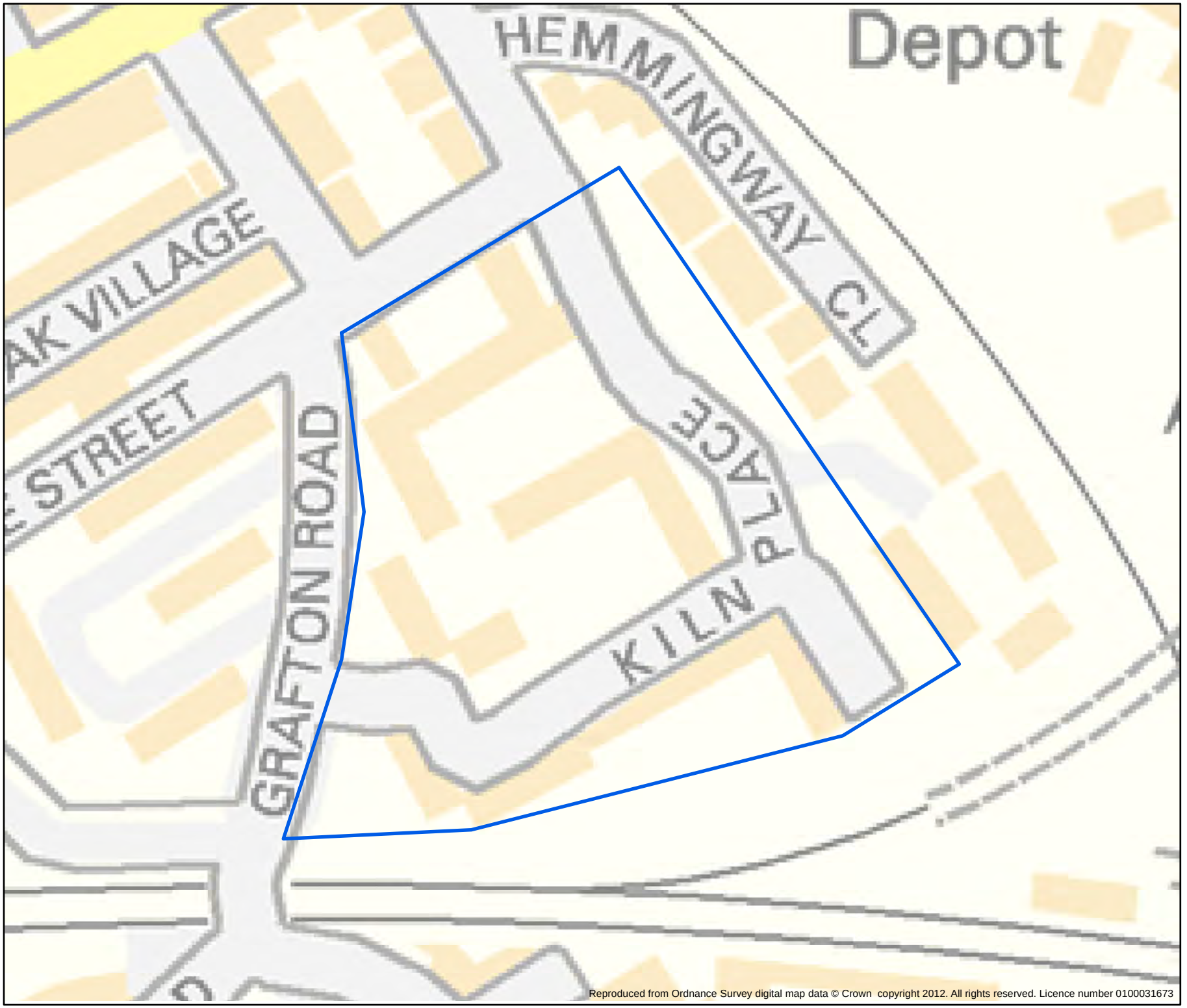
Fax: 023 8081 7600 www.ramboll.co.uk

Date	Prepared By
14/11/13	WF
Figure No.	**Revision**
1	-



Key

Site Boundary

Scale at A4 - 1:1250

N

Client

Camden Council

Project Title

Kiln Place, Camden

Project Number

61031879

Figure Title

Current Site Layout

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Date	Prepared By
14/11/13	WF
Figure No.	**Revision**
2	-

Legend

Development Plots

Scale at A4 - 1:500

N

Client

Camden Council

Project Title

Kiln Place, Camden

Project Number

61031879

Figure Title

Proposed Development

RAMBOLL

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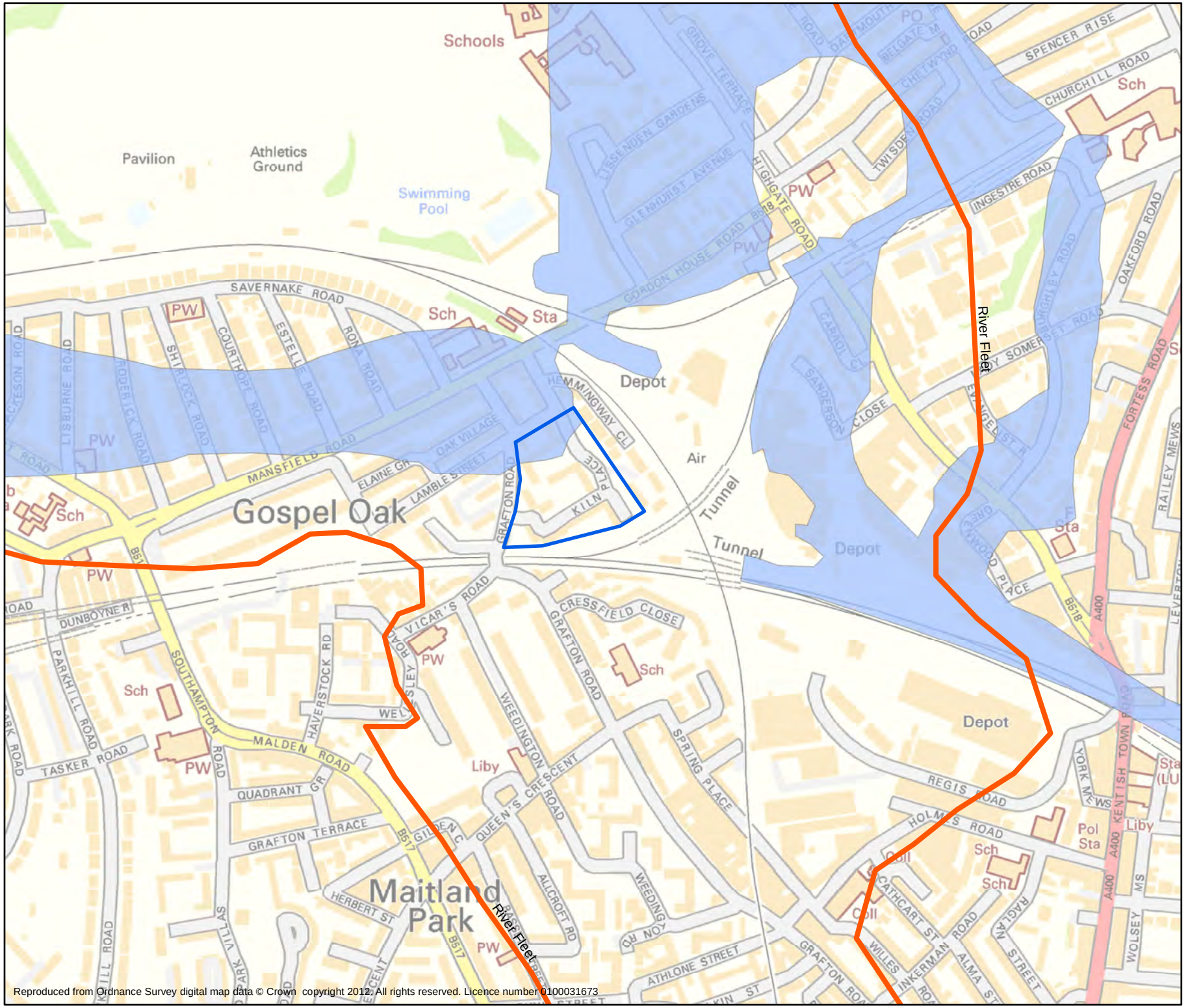
Date	Prepared By
04/09/14	BH
Figure No. 3	Revision A



Key

- Site Boundary
- Culverted Rivers
- Reservoir Flood Extent

Scale at A4 - 1:6000

N

Client

Camden Council

Project Title

Kiln Place, Camden

Project Number

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Figure Title

Water Features

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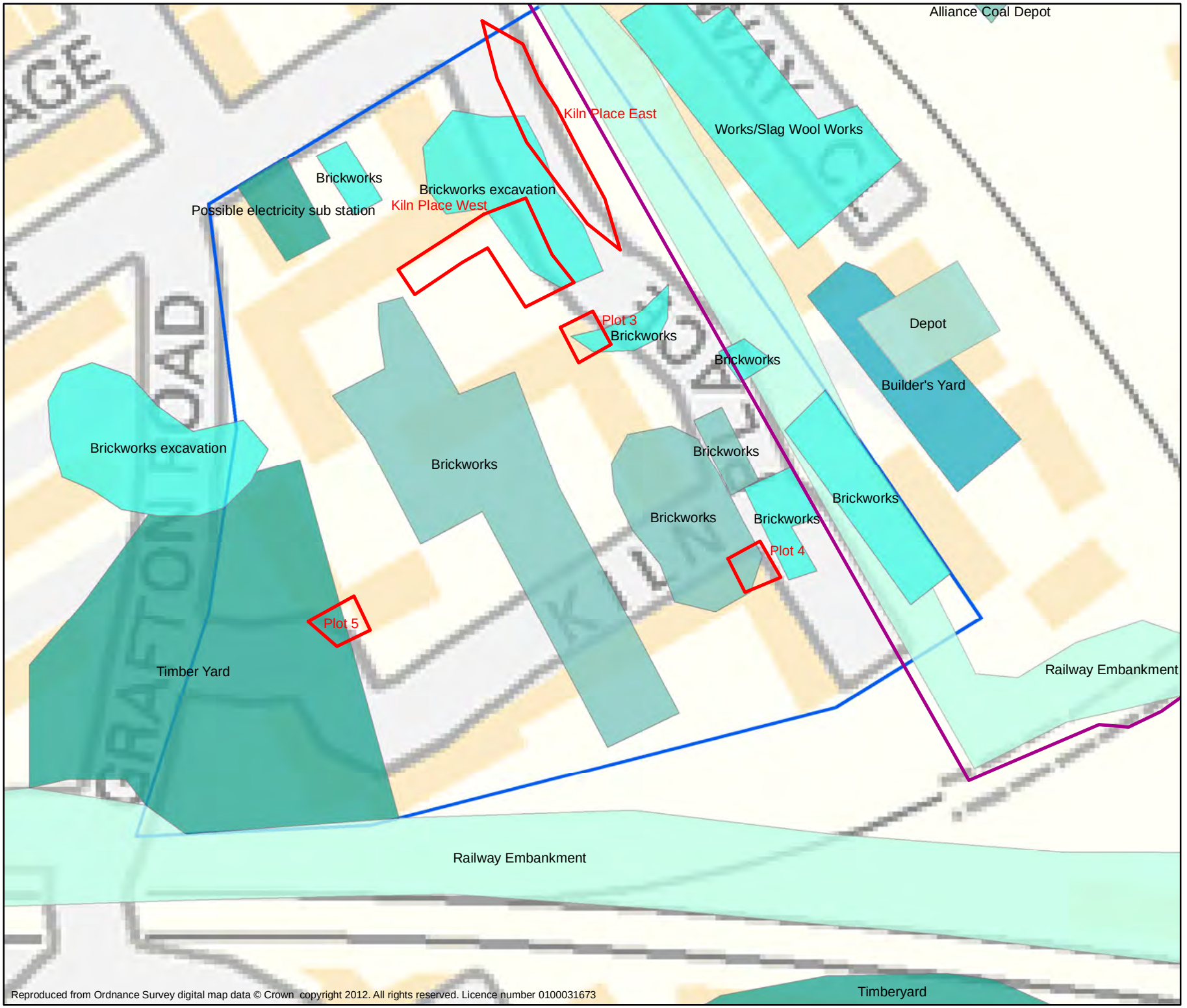
Date	Prepared By
14/11/13	WF
Figure No.	**Revision**
4	-



Key

- 1860s drain
- Development Plots
- 1863
- 1894
- 1916
- 1954
- 1970
- 1980
- Site Boundary

Scale at A4 - 1:1100

N

Client

Camden Council

Project Title

Kiln Place, Camden

Project Number

61031879

Figure Title

Potentially Contaminating Historical Site Uses

RAMBOLL

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Date	Prepared By
09/10/14	WF
Figure No.	Revision
5	-